Basic I/O Interfacing on Firebird V

e-Yantra Team

Embedded Real-Time Systems (ERTS) Lab
Indian Institute of Technology, Bombay

IIT Bombay
February 18, 2020

Agenda for Discussion

1. Input-Output Ports in ATmega 2560
   - Overview of Ports
   - Ports in ATmega 2560
   - Accessing Ports
   - Examples
2. Interfacing of GPIO Devices on Firebird V
   - Buzzer Interfacing
   - Bargraph Interfacing
   - Switch Interfacing

What are Ports?

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- Junctions where peripheral devices are connected.

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     Example: Switch, Sensors, etc...

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  2. Output Device:

     Example: Buzzer, LCD, Motors, LED, etc...

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     Port x; x = A to F and H, J, K, L
  2. ATmega 2560 has one 6-bit Port

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     Port G;
- All Port pins can be individually configured as Input/Output.

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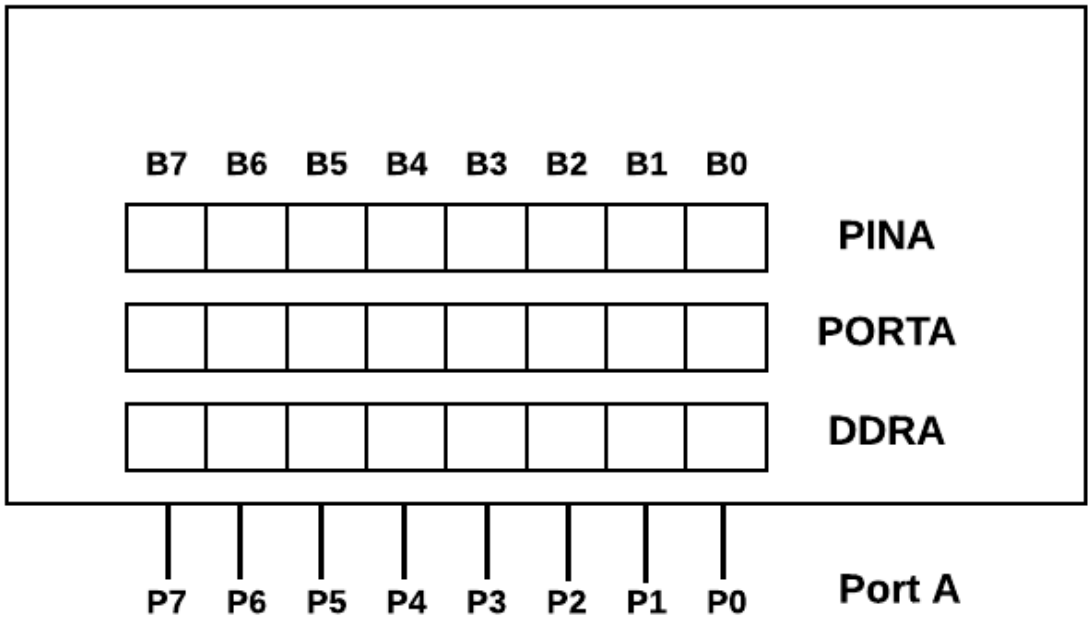

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DDRB =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	0	0	0	0

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PortC =

P7	P6	P5	P4	P3	P2	P1	P0
1	1	1	1	0	0	0	0

Understanding PINx Register

1. Purpose: To read data present on Port x pins.
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3. Example:

   Read data from Port C

PortC =

P7	P6	P5	P4	P3	P2	P1	P0
1	1	1	1	0	0	0	0

x = PINC

x = 0xF0

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1. Purpose: Send data on Port x pins
2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

Understanding PORTx Register

Case 1: When Port x is defined as Output

1. Purpose: Send data on Port x pins
2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRA = 0xFF

Understanding PORTx Register

Case 1: When Port x is defined as Output

1. Purpose: Send data on Port x pins
2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRA = 0xFF

PORTA = 0xFF

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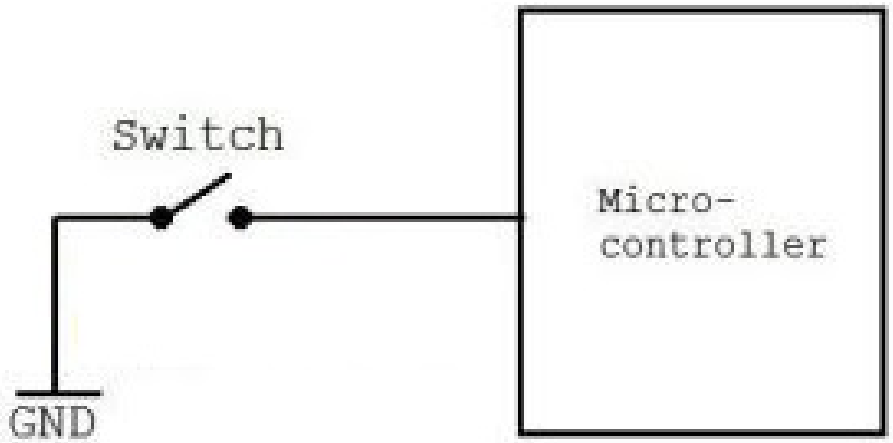

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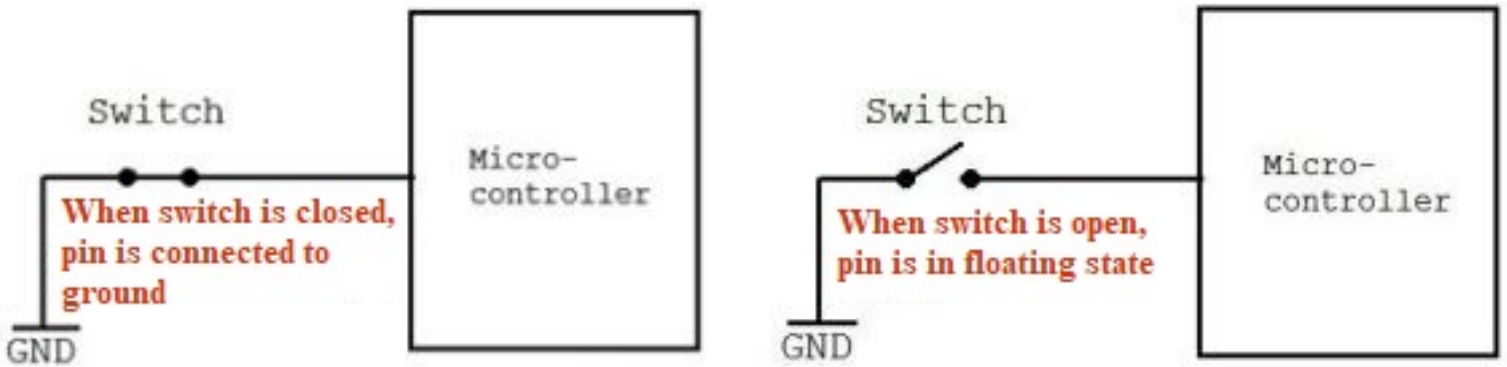

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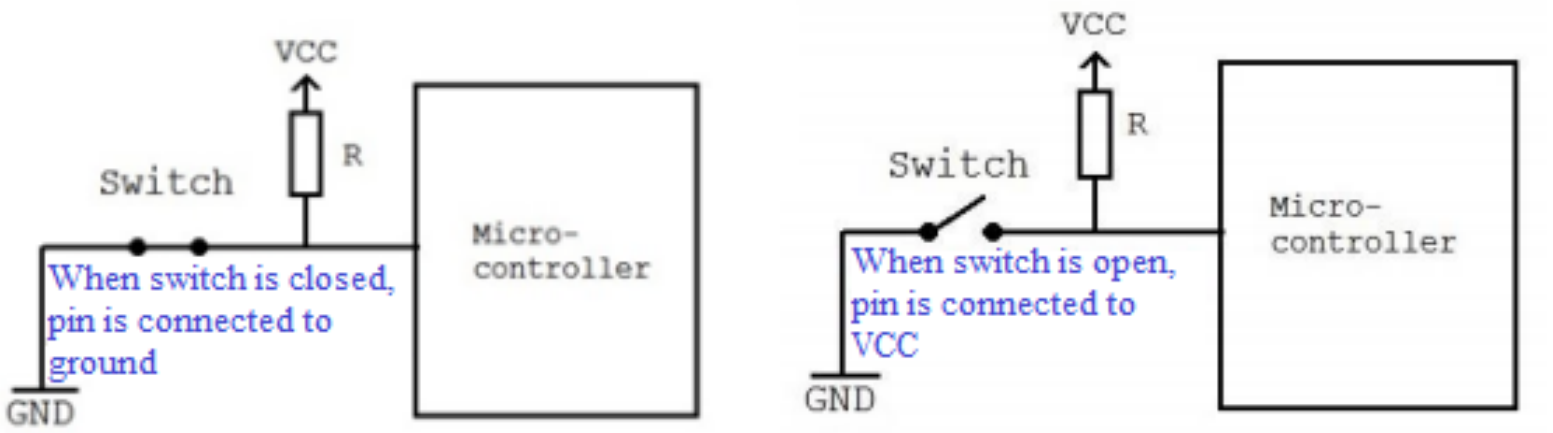

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   a. PORTx bit = 1 → Pull up is activated on Portx pin.
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DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

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   a. PORTx bit = 1 → Pull up is activated on Portx pin.
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2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

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Case 2: When Port x is defined as Input

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2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

PORTA = 0xFF

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   a. PORTx bit = 1 → Pull up is activated on Portx pin.
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2. Example:

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

PORTA = 0xFF

Pull-Up is activated for all Pins of PortA.

Examples

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- Example 1: Make PortD as output port and send hex value '0xB5'.

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1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

2. Step 2: Put data on the Port D

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

2. Step 2: Put data on the Port D

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

2. Step 2: Put data on the Port D

PORTD =

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

2. Step 2: Put data on the Port D

PORTD =

B7	B6	B5	B4	B3	B2	B1	B0
1	0	1	1	0	1	0	1

Examples

- Example 1: Make PortD as output port and send hex value '0xB5'.

1. Step 1: Make Port D as Output port

DDRD =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

DDRD = 0xFF

2. Step 2: Put data on the Port D

PORTD =

B7	B6	B5	B4	B3	B2	B1	B0
1	0	1	1	0	1	0	1

PORTD = 0xB5

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

   DDRA =

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

2. Step 2: To activate Pull-up Resistor send data on Port A

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

2. Step 2: To activate Pull-up Resistor send data on Port A

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

2. Step 2: To activate Pull-up Resistor send data on Port A

PORTA =

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

2. Step 2: To activate Pull-up Resistor send data on Port A

PORTA =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

Examples (Cont..)

- Example 2: Make PortA as input port with pull-up activated on all pins

1. Step 1: Make Port A as Input port

DDRA =

B7	B6	B5	B4	B3	B2	B1	B0
0	0	0	0	0	0	0	0

DDRA = 0x00

2. Step 2: To activate Pull-up Resistor send data on Port A

PORTA =

B7	B6	B5	B4	B3	B2	B1	B0
1	1	1	1	1	1	1	1

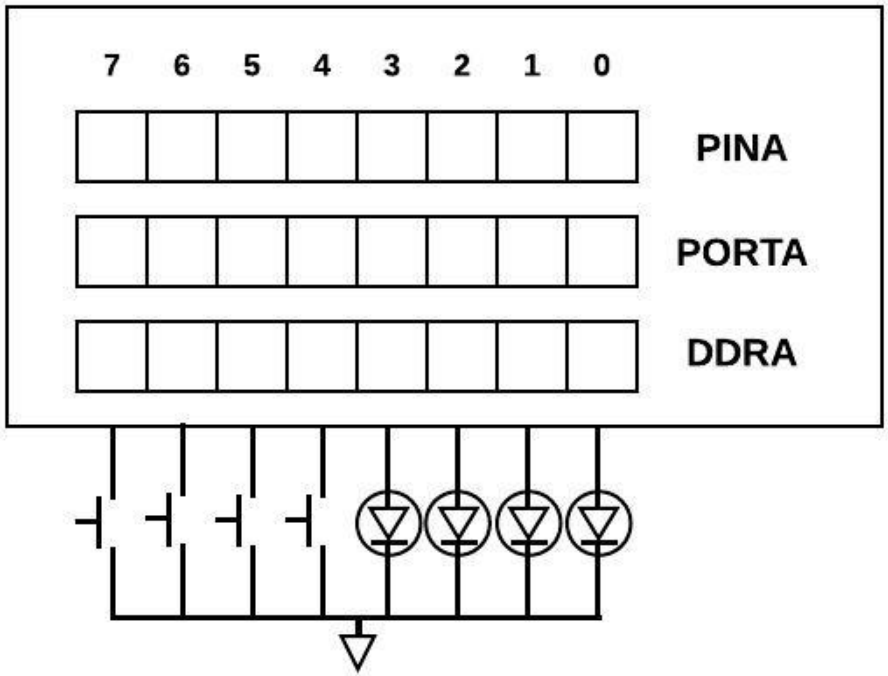
PORTA = 0xFF

Examples

- Example: Connect LEDs to lower nibble and Switches to upper nibble of PortA. Turn ON alternate LEDs (0 and 2) and activate pull up for all Switches. Read data using PIN register. What will be the content of PINA register, if only Switch at pin 5 is pressed?

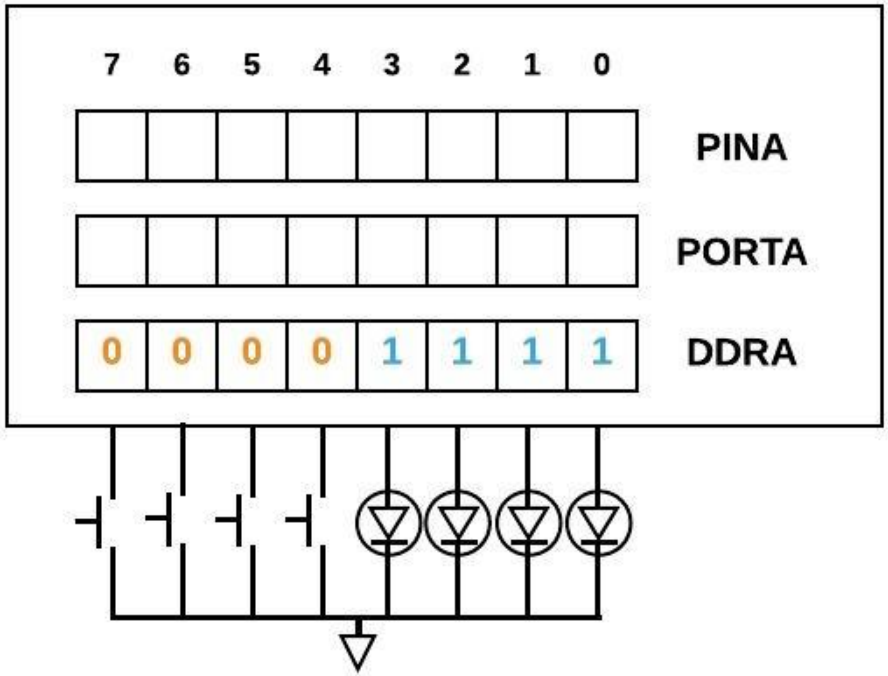
Examples

- Example: Connect LEDs to lower nibble and Switches to upper nibble of PortA. Turn ON alternate LEDs (0 and 2) and activate pull up for all Switches. Read data using PIN register. What will be the content of PINA register, if only Switch at pin 5 is pressed?



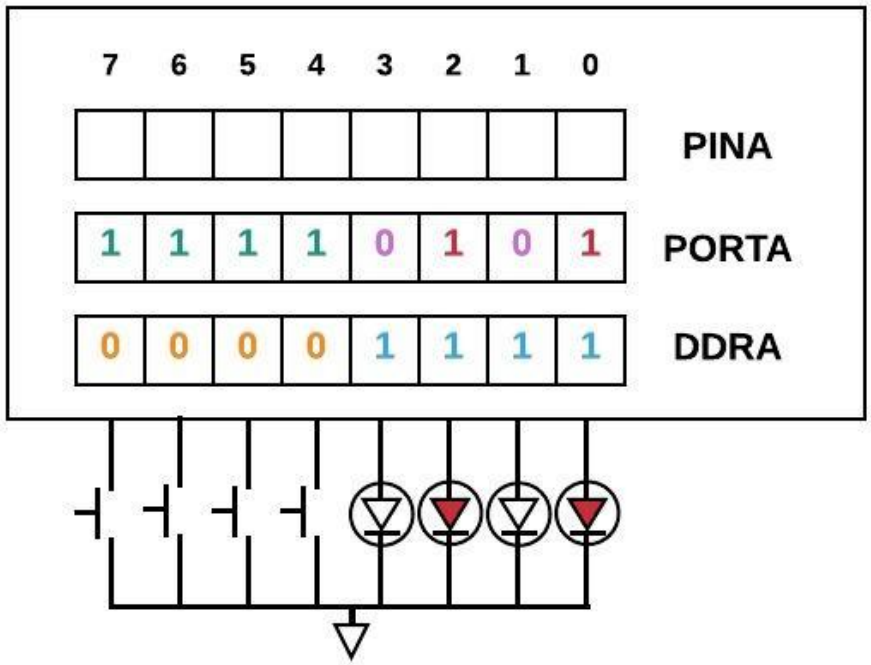
Examples

- Step 1: Make upper nibble as Input and lower nibble as Output.



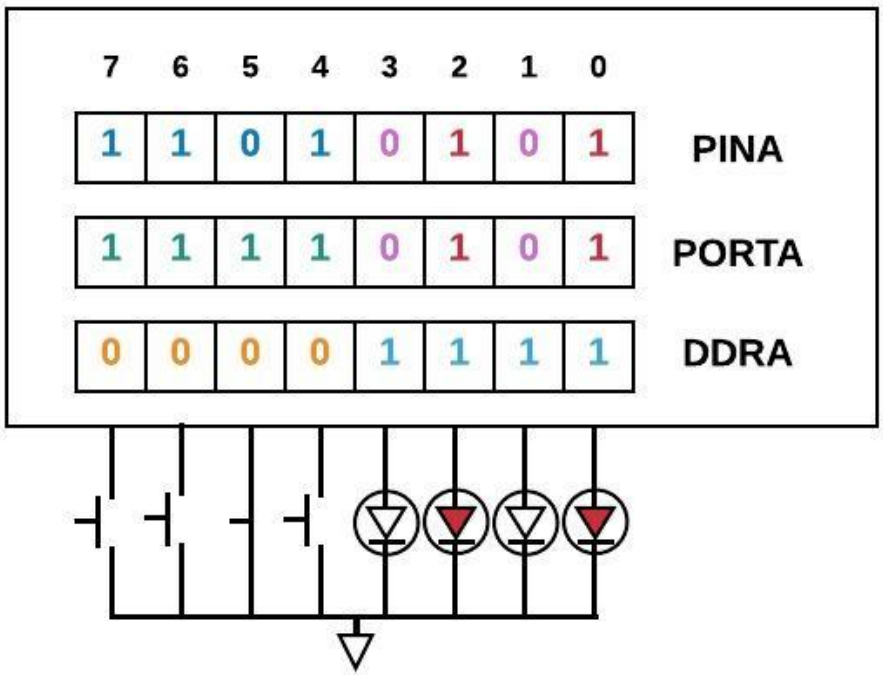
Examples

- Step 2: Turn ON alternate LEDs (0 and 2) and activate pull up for Switches.



Examples

- Step 3: Read data from PINA. On lower nibble we will get the same data and on upper nibble depending on Switch position, data will change.



Buzzer Interfacing in Firebird V

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1. Buzzer is connected to Port C pin 3

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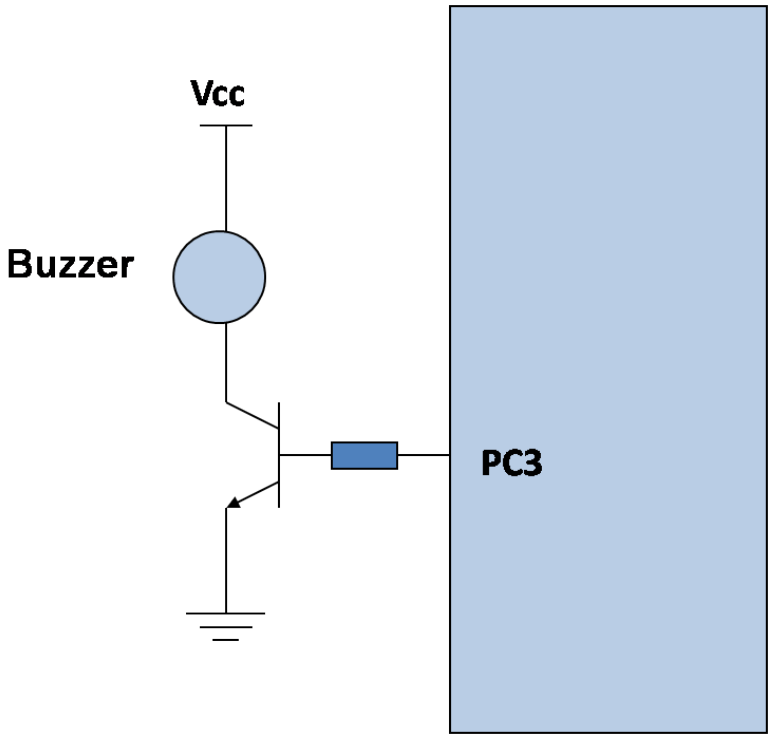

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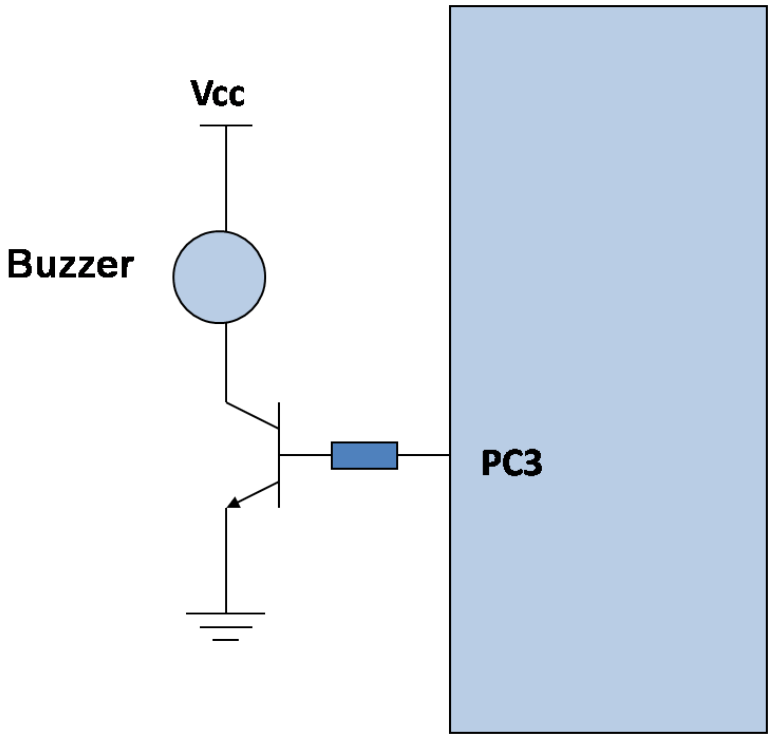

2. To turn ON buzzer:

Buzzer Interfacing in Firebird V

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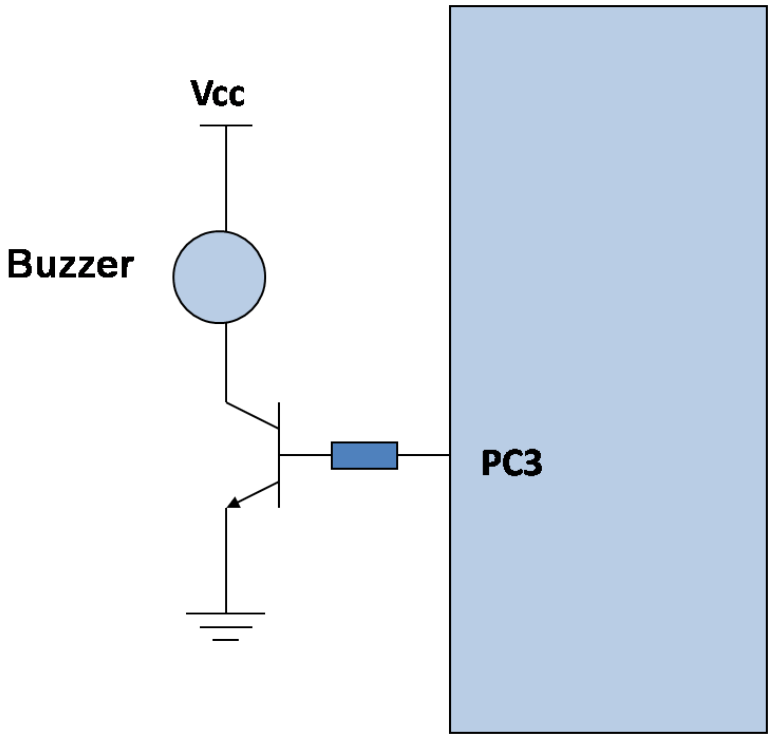

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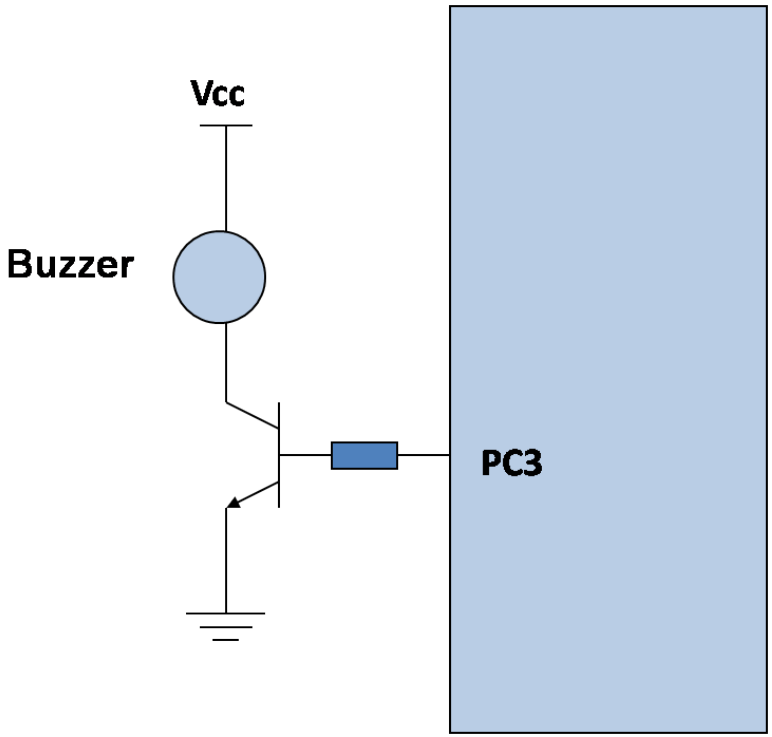

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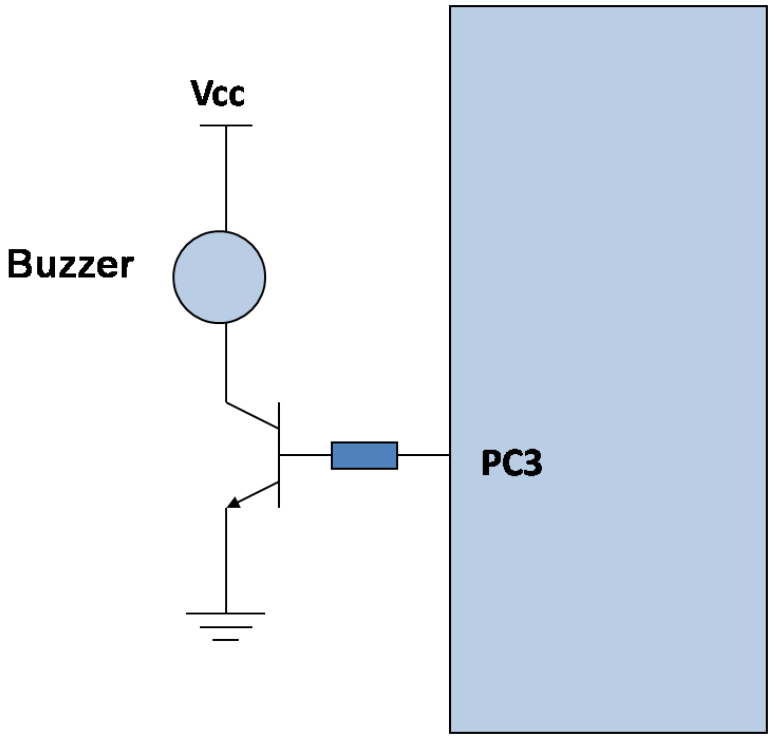

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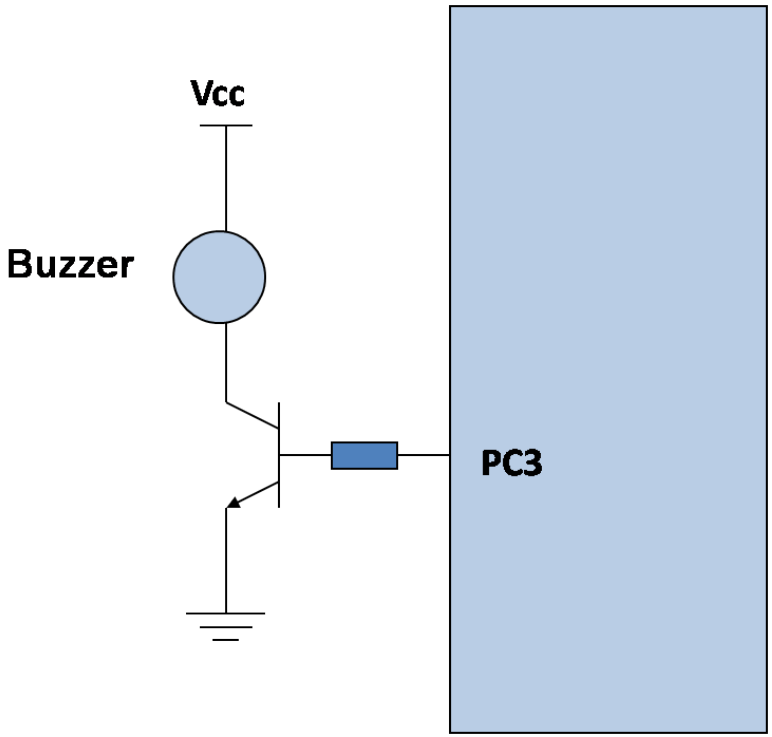

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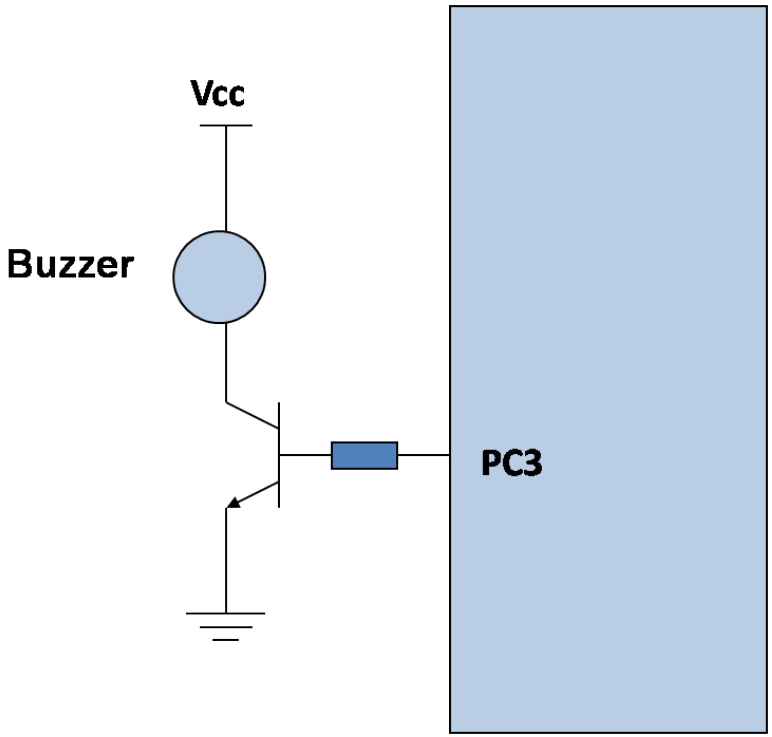
3. To turn OFF buzzer:

Buzzer Interfacing in Firebird V

1. Buzzer is connected to Port C pin 3



2. To turn ON buzzer: send logic HIGH on pin 3 of Port C
3. To turn OFF buzzer: send logic LOW on pin 3 of Port C

Buzzer Program

Buzzer Program

1. Configure PC.3 pin as Output.

Buzzer Program

1. Configure PC.3 pin as Output.

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC =

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC =

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

3. To turn OFF the buzzer set PC.3 output LOW

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

3. To turn OFF the buzzer set PC.3 output LOW

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

3. To turn OFF the buzzer set PC.3 output LOW

   PORTC =

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

3. To turn OFF the buzzer set PC.3 output LOW

   PORTC = 0x00; // 0000 0000

Buzzer Program

1. Configure PC.3 pin as Output.

   DDRC = 0x08; // 0000 1000

2. To turn ON the buzzer set PC.3 output HIGH

   PORTC = 0x08; // 0000 1000

3. To turn OFF the buzzer set PC.3 output LOW

   PORTC = 0x00; // 0000 0000

Bargraph Interfacing in Firebird V

Bargraph Interfacing in Firebird V

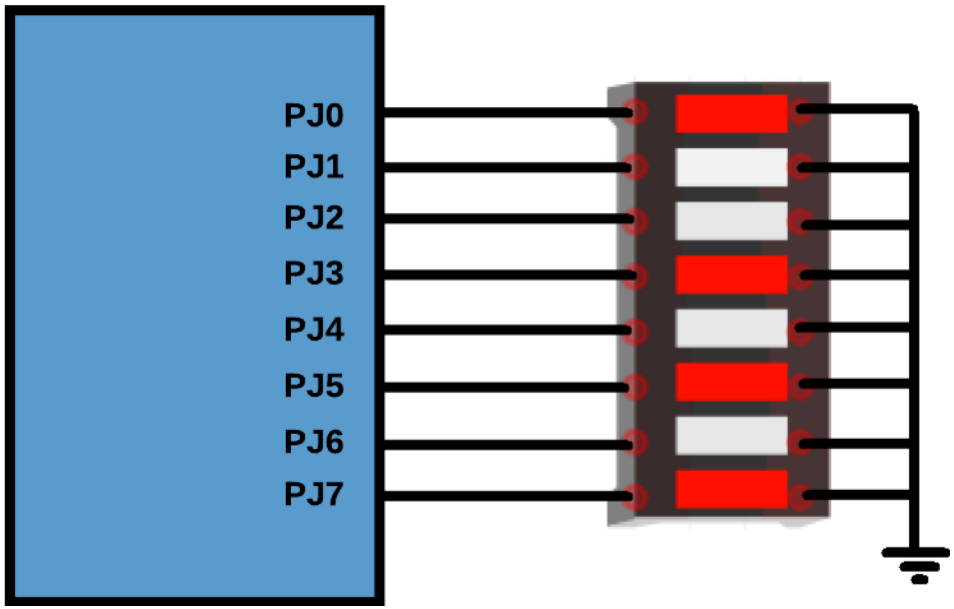
1. Bargraph are connected to Port J

Bargraph Interfacing in Firebird V

1. Bargraph are connected to Port J

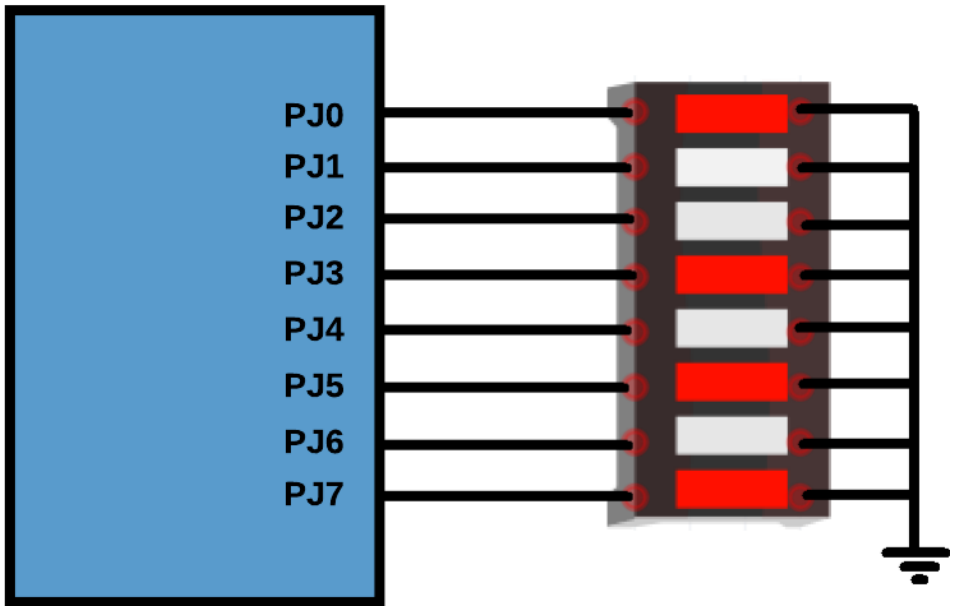
Bargraph Interfacing in Firebird V

1. Bargraph are connected to Port J



Bargraph Interfacing in Firebird V

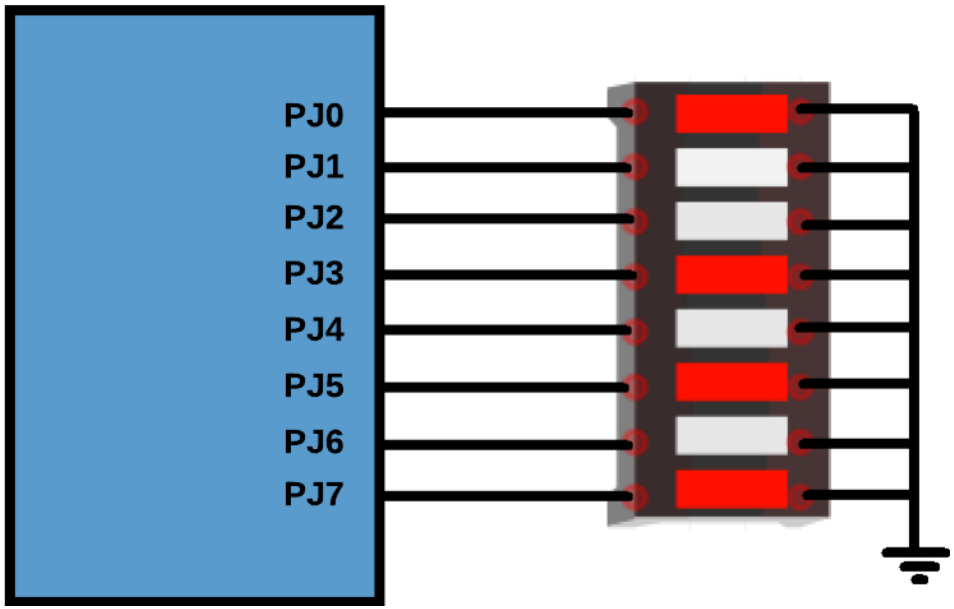
1. Bargraph are connected to Port J



2. To turn ON particular LED:

Bargraph Interfacing in Firebird V

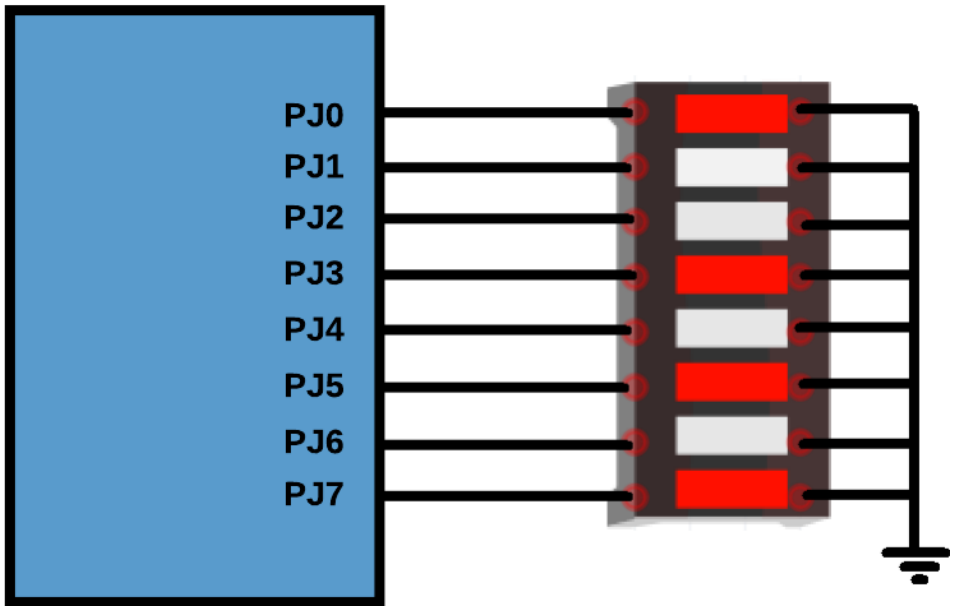
1. Bargraph are connected to Port J



2. To turn ON particular LED:

Bargraph Interfacing in Firebird V

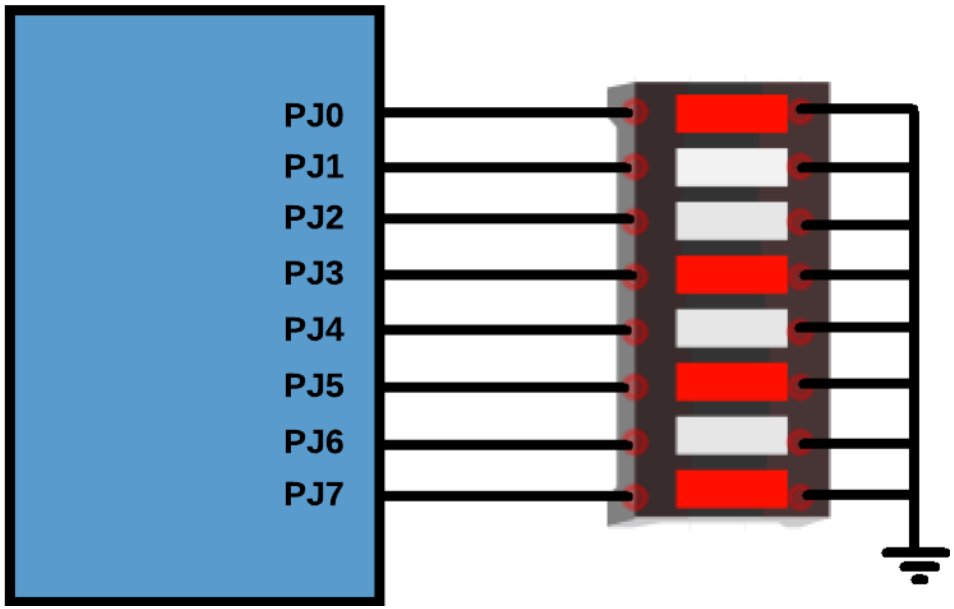
1. Bargraph are connected to Port J



2. To turn ON particular LED: send logic HIGH on corresponding pin

Bargraph Interfacing in Firebird V

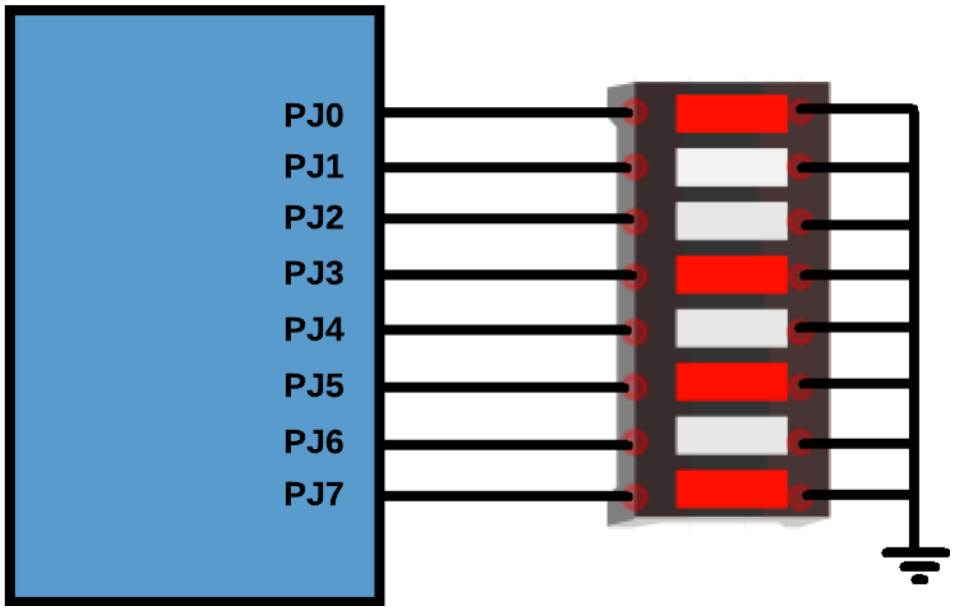
1. Bargraph are connected to Port J



2. To turn ON particular LED: send logic HIGH on corresponding pin
3. To turn OFF particular LED:

Bargraph Interfacing in Firebird V

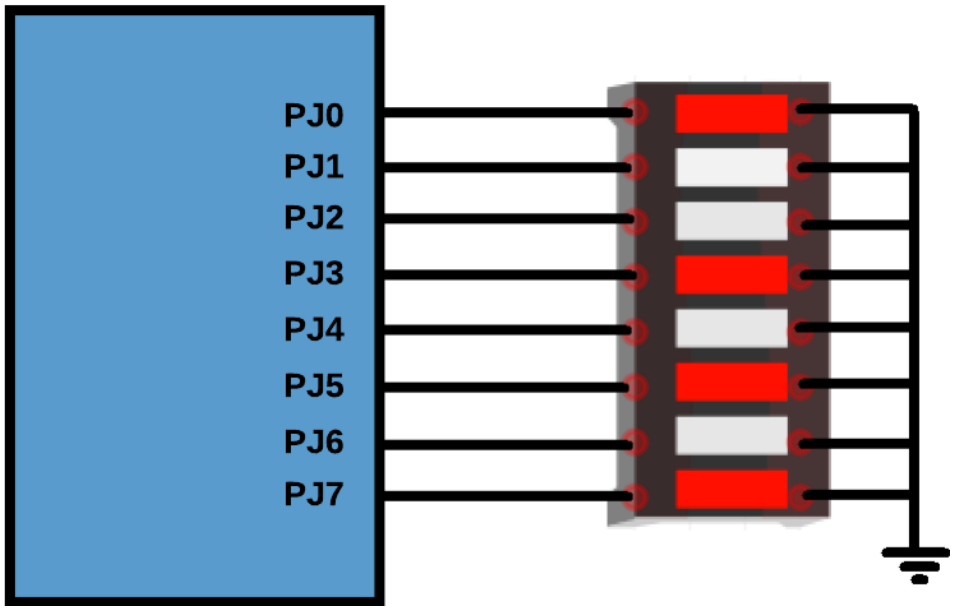
1. Bargraph are connected to Port J



2. To turn ON particular LED: send logic HIGH on corresponding pin
3. To turn OFF particular LED:

Bargraph Interfacing in Firebird V

1. Bargraph are connected to Port J



2. To turn ON particular LED: send logic HIGH on corresponding pin
3. To turn OFF particular LED: send logic LOW on corresponding pin

Switch Interfacing in Firebird V

Switch Interfacing in Firebird V

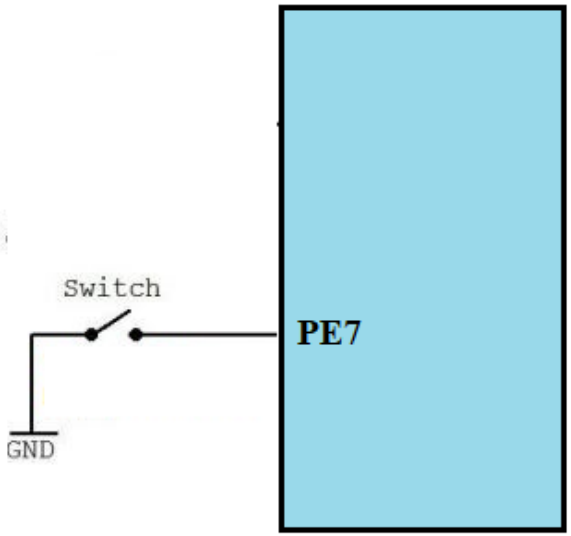
1. Switch is connected to Port E pin 7

Switch Interfacing in Firebird V

1. Switch is connected to Port E pin 7

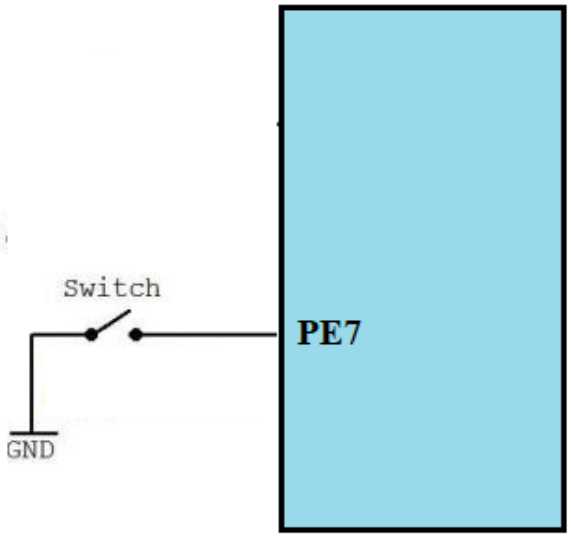
Switch Interfacing in Firebird V

1. Switch is connected to Port E pin 7



Switch Interfacing in Firebird V

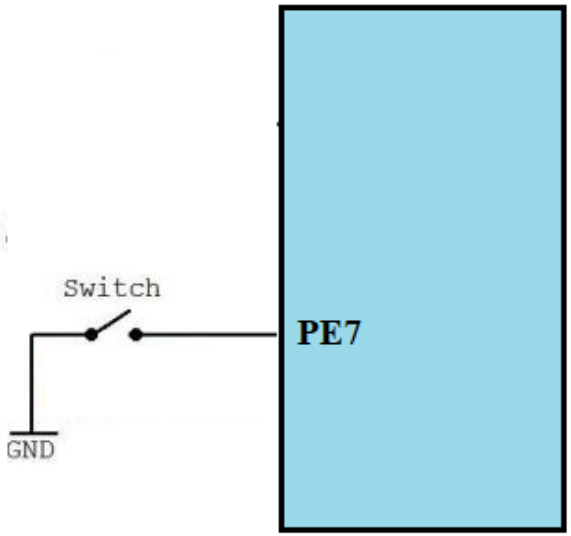
1. Switch is connected to Port E pin 7



2. When PE7 = 1 → Switch is not pressed.

Switch Interfacing in Firebird V

1. Switch is connected to Port E pin 7



2. When PE7 = 1 → Switch is not pressed.
3. When PE7 = 0 → Switch is pressed.

Thank You!